

03-06-00

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Preliminary Classification:

Proposed Class:

Subclass:

NOTE: "All applicants are requested to include a preliminary classification on newly filed patent applications. The preliminary classification, preferably class and subclass designations, should be identified in the upper right-hand corner of the letter or transmittal accompanying the application papers, for example 'Proposed Class 2, subclass 129.' M.P.E.P. § 601, 7th ed."



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Box Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

NEW APPLICATION TRANSMITTAL

Transmitted herewith for filing is the patent application of

Inventor(s): Eero NIKULA, Harri JOKINEN, Hannu VILPPONEN

WARNING: 37 C.F.R. § 1.41(a)(1) points out:

(a) A patent is applied for in the name or names of the actual inventor or inventors.

(1) The inventorship of a nonprovisional application is that inventorship set forth in the oath or declaration as prescribed by § 1.63, except as provided for in § 1.53(d)(4) and § 1.63(d). If an oath or declaration as prescribed by § 1.63 is not filed during the pendency of a nonprovisional application, the inventorship is that inventorship set forth in the application papers filed pursuant to § 1.53(b), unless a petition under this paragraph accompanied by the fee set forth in § 1.17(e) is filed supplying or changing the name or names of the inventor or inventors."

For (title): METHOD AND SYSTEM FOR REALISING A FAST CONTROL CHANNEL IN A CELLULAR RADIO NETWORK

CERTIFICATION UNDER 37 C.F.R. § 1.10*

(Express Mail label number is mandatory.)

(Express Mail certification is optional.)

I hereby certify that this New Application Transmittal and the documents referred to as attached therein are being deposited with the United States Postal Service on this date March 3, 2000, in an envelope as "Express Mail Post Office to Addressee," mailing Label Number EL336863451US, addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Debra G. Conrad

(type or print name of person mailing paper)

Debra G. Conrad

Signature of person mailing paper

WARNING: Certificate of mailing (first class) or facsimile transmission procedures of 37 C.F.R. § 1.8 cannot be used to obtain a date of mailing or transmission for this correspondence.

*WARNING: Each paper or fee filed by "Express Mail" must have the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 C.F.R. § 1.70(b).

"Since the filing of correspondence under § 1.10 without the Express Mail mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will not be granted on petition." Notice of Oct. 24, 1996, 60 Fed. Reg. 56,439, at 56,442.

(New Application Transmittal [4-1]—page 1 of 11)

1. Type of Application

This new application is for a(n)

(check one applicable item below)

- Original (nonprovisional)
- Design
- Plant

WARNING: *Do not use this transmittal for a completion in the U.S. of an International Application under 35 U.S.C. § 371(c)(4), unless the International Application is being filed as a divisional, continuation or continuation-in-part application.*

WARNING: *Do not use this transmittal for the filing of a provisional application.*

NOTE: *If one of the following 3 items apply, then complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF A PRIOR U.S. APPLICATION CLAIMED and a NOTIFICATION IN PARENT APPLICATION OF THE FILING OF THIS CONTINUATION APPLICATION.*

- Divisional.
- Continuation.
- Continuation-in-part (C-I-P).

2. Benefit of Prior U.S. Application(s) (35 U.S.C. §§ 119(e), 120, or 121)

NOTE: *A nonprovisional application may claim an invention disclosed in one or more prior filed copending nonprovisional applications or copending international applications designating the United States of America. In order for a nonprovisional application to claim the benefit of a prior filed copending nonprovisional application or copending international application designating the United States of America, each prior application must name as an inventor at least one inventor named in the later filed nonprovisional application and disclose the named inventor's invention claimed in at least one claim of the later filed nonprovisional application in the manner provided by the first paragraph of 35 U.S.C. § 112. Each prior application must also be:*

- (i) An international application entitled to a filing date in accordance with PCT Article 11 and designating the United States of America; or*
- (ii) Complete as set forth in § 1.51(b); or*
- (iii) Entitled to a filing date as set forth in § 1.53(b) or § 1.53(d) and include the basic filing fee set forth in § 1.16; or*
- (iv) Entitled to a filing date as set forth in § 1.53(b) and have paid therein the processing and retention fee set forth in § 1.21(l) within the time period set forth in § 1.53(f).*

37 C.F.R. § 1.78(a)(1).

NOTE: *If the new application being transmitted is a divisional, continuation or a continuation-in-part of a parent case, or where the parent case is an International Application which designated the U.S., or benefit of a prior provisional application is claimed, then check the following item and complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.*

WARNING: *If an application claims the benefit of the filing date of an earlier filed application under 35 U.S.C. §§ 120, 121 or 365(c), the 20-year term of that application will be based upon the filing date of the earliest U.S. application that the application makes reference to under 35 U.S.C. §§ 120, 121 or 365(c). (35 U.S.C. § 154(a)(2) does not take into account, for the determination of the patent term, any application on which priority is claimed under 35 U.S.C. §§ 119, 365(a) or 365(b).) For a c-i-p application, applicant should review whether any claim in the patent that will issue is supported by an earlier application and, if not, the applicant should consider canceling the reference to the earlier filed application. The term of a patent is not based on a claim-by-claim approach. See Notice of April 14, 1995, 60 Fed. Reg. 20,195, at 20,205.*

WARNING: When the last day of pendency of a provisional application falls on a Saturday, Sunday, or Federal holiday within the District of Columbia, any nonprovisional application claiming benefit of the provisional application must be filed prior to the Saturday, Sunday, or Federal holiday within the District of Columbia. See 37 C.F.R. § 1.78(e)(3).

- The new application being transmitted claims the benefit of prior U.S. application(s). Enclosed are ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

3. Papers Enclosed

- A.** Required for filing date under 37 C.F.R. § 1.53(b) (Regular) or 37 C.F.R. § 1.153 (Design) Application

10 Pages of specification
3 Pages of claims
4 Sheets of drawing

WARNING: DO NOT submit original drawings. A high quality copy of the drawings should be supplied when filing a patent application. The drawings that are submitted to the Office must be on strong, white, smooth, and non-shiny paper and meet the standards according to § 1.84. If corrections to the drawings are necessary, they should be made to the original drawing and a high-quality copy of the corrected original drawing then submitted to the Office. Only one copy is required or desired. For comments on proposed then-new 37 C.F.R. § 1.84, see Notice of March 9, 1988 (1990 O.G. 57-62).

NOTE: "Identifying indicia, if provided, should include the application number or the title of the invention, inventor's name, docket number (if any), and the name and telephone number of a person to call if the Office is unable to match the drawings to the proper application. This information should be placed on the back of each sheet of drawing a minimum distance of 1.5 cm. (5/8 inch) down from the top of the page . . ." 37 C.F.R. § 1.84(c).

(complete the following, if applicable)

- The enclosed drawing(s) are photograph(s), and there is also attached a "PETITION TO ACCEPT PHOTOGRAPH(S) AS DRAWING(S)." 37 C.F.R. § 1.84(b).
 formal
 informal

B. Other Papers Enclosed

 Pages of declaration and power of attorney
1 Pages of abstract
 Other

4. Additional papers enclosed

- Amendment to claims
 Cancel in this applications claims _____ before calculating the filing fee. (At least one original independent claim must be retained for filing purposes.)
 Add the claims shown on the attached amendment. (Claims added have been numbered consecutively following the highest numbered original claims.)
 Preliminary Amendment
 Information Disclosure Statement (37 C.F.R. § 1.98)
 Form PTO-1449 (PTO/SB/08A and 08B)
 Citations

- Declaration of Biological Deposit
 Submission of "Sequence Listing," computer readable copy and/or amendment pertaining thereto for biotechnology invention containing nucleotide and/or amino acid sequence.
 Authorization of Attorney(s) to Accept and Follow Instructions from Representative
 Special Comments
 Other

5. Declaration or oath (including power of attorney)

NOTE: A newly executed declaration is not required in a continuation or divisional application provided that the prior nonprovisional application contained a declaration as required, the application being filed by all or fewer than all the inventors named in the prior application, there is no new matter in the application being filed, and a copy of the executed declaration filed in the prior application (showing the signature or an indication thereon that it was signed) is submitted. The copy must be accompanied by a statement requesting deletion of the names of person(s) who are not inventors of the application being filed. If the declaration in the prior application was filed under § 1.47, then a copy of that declaration must be filed accompanied by a copy of the decision granting § 1.47 status or, if a nonsigning person under § 1.47 has subsequently joined in a prior application, then a copy of the subsequently executed declaration must be filed. See 37 C.F.R. §§ 1.63(a)(1)-(3).

NOTE: A declaration filed to complete an application must be executed, identify the specification to which it is directed, identify each inventor by full name including family name and at least one given name, without abbreviation together with any other given name or initial, and the residence, post office address and country or citizenship of each inventor, and state whether the inventor is a sole or joint inventor. 37 C.F.R. § 1.63(a)(1)-(4).

- Enclosed
Executed by

(check all applicable boxes)

- inventor(s).
 legal representative of inventor(s).
37 C.F.R. §§ 1.42 or 1.43.
 joint Inventor or person showing a proprietary interest on behalf of inventor who refused to sign or cannot be reached.
 This is the petition required by 37 C.F.R. § 1.47 and the statement required by 37 C.F.R. § 1.47 is also attached. See item 13 below for fee.

- Not Enclosed.

NOTE: Where the filing is a completion in the U.S. of an International Application or where the completion of the U.S. application contains subject matter in addition to the International Application, the application may be treated as a continuation or continuation-in-part, as the case may be, utilizing ADDED PAGE FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION CLAIMED.

- Application is made by a person authorized under 37 C.F.R. § 1.41(c) on behalf of all the above named inventor(s).

(The declaration or oath, along with the surcharge required by 37 C.F.R. § 1.16(e)
can be filed subsequently).

- Showing that the filing is authorized.
(not required unless called into question. 37 C.F.R. § 1.41(d))

6. Inventorship Statement

WARNING: If the named inventors are each not the inventors of all the claims an explanation, including the ownership of the various claims at the time the last claimed invention was made, should be submitted.

The inventorship for all the claims in this application are:

The same.

or

- Not the same. An explanation, including the ownership of the various claims at the time the last claimed invention was made,
- is submitted.
 - will be submitted.

7. Language

NOTE: An application including a signed oath or declaration may be filed in a language other than English. An English translation of the non-English language application and the processing fee of \$130.00 required by 37 C.F.R. § 1.17(n) is required to be filed with the application, or within such time as may be set by the Office. 37 C.F.R. § 1.52(d).

English

Non-English

- The attached translation includes a statement that the translation is accurate. 37 C.F.R. § 1.52(d).

8. Assignment

An assignment of the Invention to Nokia Mobile Phones Ltd.

-
- is attached. A separate "COVER SHEET FOR ASSIGNMENT (DOCUMENT) ACCOMPANYING NEW PATENT APPLICATION" or FORM PTO 1595 is also attached.

will follow.

NOTE: "If an assignment is submitted with a new application, send two separate letters-one for the application and one for the assignment." Notice of May 4, 1990 (1114 O.G. 77-78).

WARNING: A newly executed "CERTIFICATE UNDER 37 C.F.R. § 3.73(b)" must be filed when a continuation-in-part application is filed by an assignee. Notice of April 30, 1993, 1150 O.G. 62-64.

9. Certified Copy

Certified copy(ies) of application(s)

Country Finland	Appn. No. 990457	Filed 3 March 1999
Country	Appn. No.	Filed
Country	Appn. No.	Filed

from which priority is claimed

- is (are) attached.
 will follow.

NOTE: The foreign application forming the basis for the claim for priority must be referred to in the oath or declaration. 37 C.F.R. § 1.55(a) and 1.63.

NOTE: This item is for any foreign priority for which the application being filed directly relates. If any parent U.S. application or International Application from which this application claims benefit under 35 U.S.C. § 120 is itself entitled to priority from a prior foreign application, then complete item 18 on the ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

10. Fee Calculation (37 C.F.R. § 1.16)

- A. Regular application

CLAIMS AS FILED					
Number filed	Number Extra	Rate	Basic Fee 37 C.F.R. § 1.16(a) \$ 690.00		
Total					
Claims (37 C.F.R. § 1.16(c))	15 - 20 =	0	× \$ 18.00		0
Independent					
Claims (37 C.F.R. § 1.16(b))	2 - 3 =	0	× \$ 78.00		0
Multiple dependent claim(s), if any (37 C.F.R. § 1.16(d))			+ \$260.00		

- Amendment cancelling extra claims is enclosed.
 Amendment deleting multiple-dependencies is enclosed.
 Fee for extra claims is not being paid at this time.

NOTE: If the fees for extra claims are not paid on filing they must be paid or the claims cancelled by amendment, prior to the expiration of the time period set for response by the Patent and Trademark Office in any notice of fee deficiency. 37 C.F.R. § 1.16(d).

Filing Fee Calculation	\$ 690.00
B. <input type="checkbox"/> Design application (\$310.00—37 C.F.R. § 1.16(f))	
Filing Fee Calculation	\$ _____
C. <input type="checkbox"/> Plant application (\$480.00—37 C.F.R. § 1.16(g))	
Filing fee calculation	\$ _____

11. Small Entity Statement(s)

- Statement(s) that this is a filing by a small entity under 37 C.F.R. § 1.9 and 1.27 is (are) attached.

WARNING: "Status as a small entity must be specifically established in each application or patent in which the status is available and desired. Status as a small entity in one application or patent does not affect any other application or patent, including applications or patents which are directly or indirectly dependent upon the application or patent in which the status has been established. The refiling of an application under § 1.53 as a continuation, division, or continuation-in-part (including a continued prosecution application under § 1.53(d)), or the filing of a reissue application requires a new determination as to continued entitlement to small entity status for the continuing or reissue application. A nonprovisional application claiming benefit under 35 U.S.C. § 119(e), 120, 121, or 365(c) of a prior application, or a reissue application may rely on a statement filed in the prior application or in the patent if the nonprovisional application or the reissue application includes a reference to the statement in the prior application or in the patent or includes a copy of the statement in the prior application or in the patent and status as a small entity is still proper and desired. The payment of the small entity basic statutory filing fee will be treated as such a reference for purposes of this section." 37 C.F.R. § 1.28(a)(2).

WARNING: "Small entity status must not be established when the person or persons signing the . . . statement can unequivocally make the required self-certification." M.P.E.P., § 509.03, 6th ed., rev. 2, July 1996 (emphasis added).

(complete the following, if applicable)

- Status as a small entity was claimed in prior application

_____ / _____, filed on _____, from which benefit is being claimed for this application under:

- 35 U.S.C. § 119(e),
 120,
 121,
 365(c),

and which status as a small entity is still proper and desired.

- A copy of the statement in the prior application is included.

Filing Fee Calculation (50% of A, B or C above)

\$_____

NOTE: Any excess of the full fee paid will be refunded if small entity status is established and a refund request are filed within 2 months of the date of timely payment of a full fee. The two-month period is not extendable under § 1.136. 37 C.F.R. § 1.28(a).

12. Request for International-Type Search (37 C.F.R. § 1.104(d))

(complete, if applicable)

- Please prepare an international-type search report for this application at the time when national examination on the merits takes place.

13. Fee Payment Being Made at This Time

- Not Enclosed
- No filing fee is to be paid at this time.
(This and the surcharge required by 37 C.F.R. § 1.16(e) can be paid subsequently.)
- Enclosed
- Filing fee \$ 690.00
- Recording assignment
(\$40.00; 37 C.F.R. § 1.21(h))
(See attached "COVER SHEET FOR
ASSIGNMENT ACCOMPANYING NEW
APPLICATION".) \$ _____
- Petition fee for filing by other than all the
Inventors or person on behalf of the inventor
where inventor refused to sign or cannot be
reached
(\$130.00; 37 C.F.R. §§ 1.47 and 1.17(l)) \$ _____
- For processing an application with a
specification in
a non-English language
(\$130.00; 37 C.F.R. §§ 1.52(d) and 1.17(k)) \$ _____
- Processing and retention fee
(\$130.00; 37 C.F.R. §§ 1.53(d) and 1.21(l)) \$ _____
- Fee for international-type search report
(\$40.00; 37 C.F.R. § 1.21(e)) \$ _____

NOTE: 37 C.F.R. § 1.21(l) establishes a fee for processing and retaining any application that is abandoned for failing to complete the application pursuant to 37 C.F.R. § 1.53(l) and this, as well as the changes to 37 C.F.R. §§ 1.53 and 1.76(a)(1), indicate that in order to obtain the benefit of a prior U.S. application, either the basic filing fee must be paid, or the processing and retention fee of § 1.21(l) must be paid, within 1 year from notification under § 53(l).

Total fees enclosed \$ 690.00

14. Method of Payment of Fees

- Check in the amount of \$ 690.00
- Charge Account No. _____ in the amount of
\$ _____

A duplicate of this transmittal is attached.

NOTE: Fees should be itemized in such a manner that it is clear for which purpose the fees are paid. 37 C.F.R. § 1.22(b).

15. Authorization to Charge Additional Fees

WARNING: If no fees are to be paid on filing, the following items should not be completed.

WARNING: Accurately count claims, especially multiple dependent claims, to avoid unexpected high charges, if extra claim charges are authorized.

The Commissioner is hereby authorized to charge the following additional fees by this paper and during the entire pendency of this application to Account No. 16-1350:

37 C.F.R. § 1.16(a), (f) or (g) (filling fees)

37 C.F.R. § 1.16(b), (c) and (d) (presentation of extra claims)

NOTE: Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid on those claims canceled by amendment prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 C.F.R. § 1.16(d)), it might be best not to authorize the PTO to charge additional claim fees, except possibly when dealing with amendments after final action.

37 C.F.R. § 1.16(e) (surcharge for filing the basic filing fee and/or declaration on a date later than the filing date of the application)

37 C.F.R. § 1.17(a)(1)-(5) (extension fees pursuant to § 1.136(a)).

37 C.F.R. § 1.17 (application processing fees)

NOTE: "... A written request may be submitted in an application that is an authorization to treat any concurrent or future reply, requiring a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. An authorization to charge all required fees, fees under § 1.17, or all required extension of time fees will be treated as a constructive petition for an extension of time in any concurrent or future reply requiring a petition for an extension of time under this paragraph for its timely submission. Submission of the fee set forth in § 1.17(a) will also be treated as a constructive petition for an extension of time in any concurrent reply requiring a petition for an extension of time under this paragraph for its timely submission." 37 C.F.R. § 1.136(a)(3).

37 C.F.R. § 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 C.F.R. § 1.311(b))

NOTE: Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of allowance. 37 C.F.R. § 1.311(b).

NOTE: 37 C.F.R. § 1.28(b) requires "Notification of any change in status resulting in loss of entitlement to small entity status must be filed in the application . . . prior to paying, or at the time of paying, . . . the issue fee. . ." From the wording of 37 C.F.R. § 1.28(b), (a) notification of change of status must be made even if the fee is paid as "other than a small entity" and (b) no notification is required if the change is to another small entity.

16. Instructions as to Overpayment

NOTE: ". . . Amounts of twenty-five dollars or less will not be returned unless specifically requested within a reasonable time, nor will the payer be notified of such amounts; amounts over twenty-five dollars may be returned by check or, if requested, by credit to a deposit account." 37 C.F.R. § 1.26(a).

- Credit Account No. 16-1350
 Refund

DOLCE DE OLFICIO 560

SEND ALL CORRESPONDENCE TO:



SIGNATURE OF PRACTITIONER

Clarence A. Green

(type or print name of attorney)

PERMAN & GREEN, LLP

P.O. Address

425 Post Road, Fairfield, Connecticut 06430

(New Application Transmittal [4-1]—page 10 of 11)

Incorporation by reference of added pages

(check the following item if the application in this transmittal claims the benefit of prior U.S. application(s) (including an international application entering the U.S. stage as a continuation, divisional or C-I-P application) and complete and attach the ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED)

- Plus Added Pages for New Application Transmittal Where Benefit of Prior U.S. Application(s) Claimed

Number of pages added _____

- Plus Added Pages for Papers Referred to in Item 4 Above

Number of pages added _____

- Plus added pages deleting names of inventor(s) named in prior application(s) who is/are no longer inventor(s) of the subject matter claimed in this application.

Number of pages added _____

- Plus "Assignment Cover Letter Accompanying New Application"

Number of pages added _____

Statement Where No Further Pages Added

(if no further pages form a part of this Transmittal, then end this Transmittal with this page and check the following item)

- This transmittal ends with this page.

TITLE: Method and system for realising a fast control channel in a cellular radio network

TECHNOLOGICAL FIELD

- 5 The invention concerns the mapping of such logical channels into the physical channel arrangement in a cellular radio network that are not continuously needed but only used to convey some urgent control information according to need.

BACKGROUND OF THE INVENTION

- 10 In the well-known GSM (Global System for Mobile communications) there has been specified the so called FACCH or Fast Associated Control Channel which is used for example to indicate the call establishment progress, to authenticate a subscriber or to command a handover. It is common to these "fast" signalling needs that all delays should be minimized and the conveyed information should be received over the radio interface as faultlessly as possible. As a background to the present invention we will shortly describe the known properties of a FACCH. A detailed description is found for example in the technical specifications number 15 GSM 05.01, GSM 05.02 and GSM 05.03 published by the European Telecommunications Standards Institute.
- 20 The FACCH actually involves the use of the burst structure on a regular TCH or Traffic Channel to temporarily convey "fast" signalling information instead of user data. The transmitting device packs the desired fast signalling information into a FACCH frame which, after channel coding, consists of 456 bits. At the interleaving stage the FACCH frame is split into 8 groups of 57 bits. The bits of the first group are transmitted in the even bit positions of a certain Nth transmission burst and the bits of the next groups go to the even bit positions of the next transmission bursts until the bits of the fourth group are transmitted in the even bit positions of the (N+3)th transmission burst. The bits of groups 5 to 8 are then transmitted in the odd bit positions of the transmission bursts N+4 to N+7 respectively. Certain stealing 25 flags (i.e. indicator bits) are used within each transmission burst to indicate whether the even (or odd) bit positions of that particular transmission burst contain user data or fast signalling information. In other words the FACCH frame will be conveyed to the receiving device by using every second bit position in 8 consecutive trans- 30

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mission bursts of a certain traffic channel. If there is only one FACCH frame to be transmitted, all the other bit positions are used to convey user data.

- As an example of the extensions to and developments over the existing cellular radio networks we will describe the proposed Enhanced Circuit Switched Data or ECSD arrangement which is currently being specified as a part of the Enhanced Data rates for GSM Evolution or EDGE programme. ECSD is based on enhancing the effective user data rates over the radio interface by employing 8-level Phase Shift Keying (8-PSK) as an alternative to the Gaussian Minimum Shift Keying or GMSK modulation method of GSM. A straightforward solution for implementing the fast signalling channels within ECSD would be to copy the above-described method as closely as possible. In other words the information contents of an FACCH frame would be distributed selectively to the even and odd symbol positions in the 8-PSK modulated transmission bursts, and stealing flag symbols would be used to indicate the nature of the contents of each transmission burst.
- However, one must note that 8-PSK as a modulation method requires a higher bit energy over noise density ratio (commonly referred to as E_b/N_0) than GMSK to achieve a certain required level of faultlessness in the received information. It is therefore expected that simply adopting the GSM FACCH mechanisms in ECSD would lead to inadequate performance for the FACCH.
- A proposed solution is to otherwise adopt the GSM practice but to use different detection metrics for the user data and fast signalling information, i.e. to effectively employ binary modulation like GMSK or BPSK (Binary Phase Shift Keying) for the FACCH symbols. This solution is unattractive from the receiver designer's point of view, because it would require a receiver to be able to detect every other symbol in a symbol sequence with a different detection algorithm. Another solution is to use a completely different physical channel with different channel specifications for conveying the fast signalling information, but this alternative tends to lead into complicated hardware structures.

30 SUMMARY OF THE INVENTION

It is an object of the present invention to provide a method and an arrangement for combining the transmission of fast signalling information to the transmission of user data in a multilevel modulation environment without sacrificing the performance of

the logical signalling channel and without introducing a high level of complexity to the transmitter and receiver arrangements.

- The objects of the invention are achieved by packing the fast signalling information into continuous blocks of the transmission bursts at the interleaving stage and using 5 a less sensitive modulation method for the transmission of fast signalling information than for user data.

The method according to the invention is characterized in that it comprises the steps of

- formatting a piece of signalling information into symbols,
- 10 - transmitting the symbols carrying the signalling information as a block of consecutive symbols in a certain transmission burst of a traffic channel and
- indicating within said certain transmission burst that it contains symbols carrying signalling information.

The invention applies also to a transmitting device which is characterized in that it 15 comprises means for carrying out the above-mentioned steps.

The invention is based on the insight that it is not necessary to bring the interleaving down to the bitwise alternation between user data and signalling information. The interleaving algorithms may be designed so that the signalling information reserves continuous blocks from the transmission bursts. A very simple solution is to allocate 20 complete transmission bursts to the fast signalling purposes according to need.

Another possibility is to use the fact that in many systems a transmission burst is divided into two temporally separate halves by a training sequence at the middle of the transmission burst, so one of the halves may be allocated to fast signalling information and the other to user data. The invention allows even the use of smaller 25 continuous symbol blocks within the transmission frames for conveying fast signalling information, but the smaller the size of the continuous block the closer the solution gets to the disadvantages of directly copying the existing FACCH practice from GSM.

The indication of the contents of a transmission burst as either fast signalling 30 information or user data may be accomplished through the use of stealing symbols like in the prior art solutions. However, one may also take advantage of the phase rotation characteristics associated with the different modulation methods by using the rotation of the constellation points in the phase space as an indication of the transmission burst contents. Each transmission burst contains a training sequence

the symbol content of which is known, so a receiver can use the received form of the training sequence to find out a correct phase derotation angle. Associating a certain unique phase rotation angle to each modulation method is thus a feasible way of conveying a piece of simple modulation-related information.

- 5 A lower-level modulation method generally allows the use of higher transmission power, because the nonlinear phase characteristics of the transmitter's power amplifier have a relatively smaller distorting effect on the signal. Therefore the invention allows also the enhancement of the fast signalling performance by transmitting the signalling information with a higher transmission power than the
10 corresponding user data.

BRIEF DESCRIPTION OF DRAWINGS

The novel features which are considered as characteristic of the invention are set forth in particular in the appended Claims. The invention itself, however, both as to

- 15 its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

Fig. 1 illustrates the transmission of fast signalling information according to a first embodiment of the invention,

- 20 Fig. 2 illustrates the transmission of fast signalling information according to a second embodiment of the invention,

Fig. 3 illustrates a possible interleaving scheme that can be used in connection with the embodiment of Fig. 1,

25 Fig. 4 illustrates the use of phase rotation to identify some characteristics of a transmission burst,

Fig. 5 is a schematic illustration of a method according to an embodiment of the invention and

Fig. 6 is a schematic illustration of the hardware associated with an embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Fig. 1 shows schematically a transmitting device 101, a receiving device 102 and a number of transmission bursts 111 to 120 transmitted from the former to the latter. We assume that previously a traffic channel or TCH has been established between the devices for transmitting some kind of user data. We also assume that in the middle of the user data transmission a piece of fast signalling information has to be transmitted. Further we assume that the amount of fast signalling information is such that in the channel encoded form it would completely fill four transmission bursts. Comparing to the known FACCH terminology of GSM this means that there is a single FACCH frame to be transmitted.

According to the embodiment of Fig. 1, four complete consecutive transmission bursts 114, 115, 116 and 117 are "stolen" from the traffic channel to transmit the fast signalling information. Taken that a different modulation method will be used to transmit the fast signalling information than the user data, allocating complete transmission bursts has the advantage that the allocation requires the transmitting device 101 to reconfigure its modulator (not separately shown) only twice – between transmission bursts 113 and 114 and between transmission bursts 117 and 118. Also the receiving device 102 has to reconfigure its demodulator (not separately shown) only twice, with plenty of time to do so. This is definitely more advantageous than the prior art alternative of applying a different modulation method to every second symbol in a number of transmission bursts. It must be noted, however, that the transmission bursts shown in Fig. 1 relate only to a single connection: if we suppose that the transmitting device 101 is a base station it may have dozens of simultaneous connections active at any given moment. The specifications of ECSD state that a transmission frame consists of eight time slots, so on a given frequency a base station may need to transmit up to seven other transmission bursts between each pair of consecutive transmission bursts in Fig. 1. Depending on the data rate used in each connection, the base station may need to reconfigure its modulator to a different modulation method even after every transmission burst in a transmission frame. Under some specific conditions there may be even more than one transmission burst – with an associated change of modulation method – within a single time slot.

The number of transmission bursts that must be stolen from the traffic channel to the transmission of fast signalling information is not limited by the invention: it depends on the amount of fast signalling information to be transmitted and on the amount of channel coding applied to encode the fast signalling information. Also

the invention does not require that the stolen transmission bursts are consecutive for example every second or every third transmission burst or any number of N transmission bursts from M , where $N < M$, in any order could be stolen. However not stealing consecutive transmission bursts will at least partly eliminate the advantage of having to change the modulation/demodulation method only few times. Spreading the transmitted fast signalling information over a large number of transmission bursts also causes delay in getting the complete set of fast signalling information through to the receiving device.

Fig. 2 illustrates an alternative embodiment where the transmitting device 101 and receiving device 102 are essentially the same but from the transmission bursts 211 to 220, one physical half of the bursts 212 to 219 is allocated to fast signalling information. Physical half means that when there is a training sequence in the middle of each transmission burst, all symbols preceding the training sequence (as in transmission bursts 212 to 215) or all symbols following the training sequence (as in transmission bursts 216 to 219) are allocated. This embodiment requires several changes between modulation/demodulation methods, but it is still more advantageous than changing the modulation/demodulation method after each symbol. It has also the advantage of not cutting completely the transmission of user data for the duration of several frames as in the embodiment of Fig. 1. Again the invention does not limit the number of transmission bursts of which one half is allocated to fast signalling information, nor the order in which the first and second halves are allocated. Between the transmission bursts from which one half is allocated to fast signalling information there may be complete user data bursts.

Basically the invention allows even for smaller blocks of transmission bursts to be allocated to fast signalling information: for example the K last symbols (where K is an integer smaller than the number of symbols in one half of a transmission burst) of each transmission burst for the duration of P transmission bursts (where P is a positive integer) could be allocated. However, allocating complete transmission bursts or physical burst halves is regarded as more advantageous, because in these embodiments the limits of the allocated symbol block are very clearly defined.

Fig. 3 illustrates schematically an advantageous method for interleaving the contents of a fast signalling information frame 301 to a number of transmission bursts. We assume that the method of Fig. 1 is used, whereby the contents of the fast signalling information frame 301 will completely fill four transmission bursts 310 to 313. In Fig. 3, the frame is first split into eight groups 302 to 309 each having an equal number of symbols. The symbol positions in the "stolen" transmission bursts are

then filled in order by first taking the first symbol from each group as illustrated by lines in Fig. 3, then taking the second symbol from each group and so on. In other words, the symbols from the n th group (where n goes from 1 to 8) take the position: n , $n+8$, $n+16$ and so on. Fig. 3 also shows the training sequence as a hatched block in the middle of each transmission burst 310 to 313, as well as a pair of stealing flag indicator symbols shown in solid black, one on each side of each training sequence. The interleaving method of Fig. 3 is naturally only exemplary, and a number of other interleaving methods are applicable.

There are basically two ways of indicating, which transmission bursts and which parts of them comprise fast signalling information instead of user data. Stealing flag indicator symbols were already mentioned above, meaning that the value of a first stealing flag indicates whether a first half of the transmission burst contains fast signalling information and the value of a second stealing flag similarly indicates whether a second half of the transmission burst contains fast signalling information.

We will describe an alternative method of implementing the indication with reference to Fig. 4.

Fig. 4 illustrates an assembled transmission frame 401 in the form which it has in a transmitting device before modulation onto a carrier frequency. In the middle of the transmission burst there is a training sequence which consists of a string of known consecutive symbols. The schematic indication ABABAB... has been used for the known form of the training sequence. The modulation step is accompanied with a phase rotation which may be an inherent consequence of the applied modulation algorithm or which may be introduced deliberately as an addition to the actual modulation. An exemplary way of applying phase rotation is the following.

According the 8-PSK modulation principle there are eight allowed phase angle values for the modulated signal, e.g. 0 , $\pm\pi/4$, $\pm\pi/2$, $\pm3\pi/4$, π . Each of them corresponds to a particular set of three consecutive bits in the data stream to be transmitted: for example the bit combination $(0,1,0)$ corresponds to a phase angle value $+\pi/2$. A constant phase rotation by X radians may be specified so that each symbol generated according to the basic modulation principle will be additionally rotated by X radians in the phase space. For example defining $X = +3\pi/8$, the final phase modulated symbol that will represent the bit combination $(0,1,0)$ in the transmitted signal will have the phase angle value $+7\pi/8$.

In Fig. 4 the modulated, phase rotated and transmitted transmission frame 402 consists of phase rotated symbols. A receiving device must perform demodulation and derotation operations to restore the original information contents 403 of the

transmission frame. Note that the receiving device knows beforehand the form of the training sequence, so it may deduce that the correct phase derotation angle is the one which causes the training sequence to acquire its correct original form.

- If a certain first phase rotation scheme is applied to transmit complete bursts containing user data, and a certain second phase rotation scheme is used to transmit complete bursts containing fast signalling information, no other indication mechanism is actually needed: a receiving device recognises the used phase rotation scheme by finding out which phase derotation scheme produces the correct form of the training sequence and deduces therefrom the nature of the contents of the transmission burst. If, on the other hand, the phase rotation scheme is independent of the contents of the transmission burst or only a part of the transmission burst contains fast signalling information, a stealing flag mechanism is needed for the indication.

To summarize, we may state that the invention allows for the following indication mechanisms:

- use different phase rotation schemes and no separate stealing flag indicator symbols;
- use same phase rotation scheme and separate stealing flag indicator symbols; or
- use different phase rotation schemes and as a back-up separate stealing flag indicator symbols.

If stealing flag indicator symbols are used, it is most advantageous to choose their two allowed values so that they correspond to opposite points in the constellation diagram.

- The question of possible confusion between the GMSK-modulated fast signalling information bursts and possible other GMSK-modulated bursts deserves to be briefly mentioned. It has been proposed that a slow associated control channel or SACCH would use GMSK modulation in ECSD. To prevent confusion it is necessary that such an SACCH uses only certain previously known transmission bursts. If the model of GSM is followed, the SACCH will have a number of fixedly allocated slot positions in each cell, so as long as the fixed slot allocations are obeyed there is no danger of the SACCH bursts to get mixed with potential GMSK modulated fast signalling information bursts. The same applies to potential other bursts to which the same modulation method will be applied.

A transmitting device in a cellular radio network typically has a certain upper limit of allowed transmission power for each transmission burst. If the embodiment of Fig. 1 (allocation of complete bursts to fast signalling information) is used, it is possible to use a higher transmission power to transmit the bursts stolen to the use of fast signalling information than the regular bursts. This is due to the fact that the nonlinearity of a transmission power amplifier (especially in a base station) will become more evident if a multilevel phase modulation method is used than with a binary modulation method, imposing a mandatory 2-4 dB back-off at the highest 8-PSK transmission power levels. Not having to impose the back-off when transmitting the fast signalling information is a remarkably advantage, because the highest power levels relate to the situations where a terminal is near a cell border, and the fast signalling information often carries handover-related information which should be received as faultlessly as possible.

It should be noted that using higher downlink transmission power levels for fast signalling information will affect the received power measurements and reporting performed by the mobile stations. The network must compensate for the corresponding unreasonably high measurement results. The techniques for implementing such compensation are within the normal capabilities of a person skilled in the art.

We will conclude by briefly describing the effect of the invention on the structure and functions of transmitting and receiving devices such as base stations and terminals of a cellular radio network. As illustrated in the upper part of Fig. 6 a transmitting device comprises a user data channel encoder block 601, a fast signalling channel encoder block 602 and a burst formatting block 603 to pack the channel encoded symbols into bursts. The latter operates under the command of a burst formation control block 604 and may receive the correct form of the training sequence from a training sequence generator 603'. The inputs to the channel encoder blocks come in a known way from user data formation (e.g. microphone and speech encoder in a telephone) and fast signalling data formation (a control processor), and the burst formation control is typically a subblock of a larger system control block. The formatted bursts are transmitted by a transmitter block 605 which applies the modulation and phase rotation methods commanded by the burst formation control block 604.

In a receiving device a receiver block 606 receives the transmitted bursts and converts them into baseband symbol sequences using the demodulation method commanded again by a control block 608. The burst decomposition block 607 strips

- the received bursts from training sequences and other overhead information and submits the actual user data symbols to the user data channel decoding block 609 and the fast signalling information symbols to the fast signalling channel decoding block 610. The operation of the control block 608 depends on which information it
5 has received from the receiver block in the form of detected phase rotation characteristics and/or from the burst decomposition block 607 in the form of stealing flag indicator symbol values. The decoding blocks 609 and 610 are in a known way coupled to the parts of the receiving device where the decoded user data and signalling information is needed, and the control block 608 is again typically a
10 part of a larger system control functionality.

- According to the invention the blocks 604 and 603 in the transmitting device are arranged to allocate complete transmission bursts or burst halves to the use of fast signalling information; additionally the control block 604 is arranged to command the transmitter to use a binary phase modulation method for the fast signalling
15 information symbols. In the receiver the blocks 607 and 608 are correspondingly arranged to divert complete fast signalling bursts or burst halves to block 610 when they appear. If the phase rotation based indication mechanism is used, the receiver block 606 is also arranged to detect the phase rotation characteristics of the received symbols and to announce them to the control block 608.
20 Although ECSD has been mentioned as the primary area of application for the invention, the invention is equally applicable to all such cellular radio networks and systems where two modulation levels of different depth are available to transmit user data and fast signalling information, and where additionally the transmission of fast signalling information takes place using capacity "stolen" from the user data.

CLAIMS

1. A method for conveying signalling information from a transmitting device to a receiving device in a cellular radio network where user data transmission takes place on a traffic channel in discrete transmission bursts consisting of consecutive symbols, comprising the steps of:
- formatting a piece of signalling information into symbols,
 - transmitting the symbols carrying the signalling information as a block of consecutive symbols in a certain transmission burst of a traffic channel and
 - indicating within said certain transmission burst that it contains symbols carrying signalling information.
2. A method according to claim 1, wherein the step of transmitting the symbols carrying the signalling information comprises the substep of filling a complete transmission burst with the symbols carrying the signalling information.
3. A method according to claim 2, wherein the step of transmitting the symbols carrying the signalling information comprises the substep of filling a number of consecutive complete transmission bursts with the symbols carrying the signalling information.
4. A method according to claim 2, wherein the step of transmitting the symbols carrying the signalling information comprises the substep of filling a number of non-consecutive complete transmission bursts with the symbols carrying the signalling information.
5. A method according to claim 1, wherein additionally a transmission burst consists of a first half, a training sequence and a second half, and the step of transmitting the symbols carrying the signalling information comprises the substep of filling exactly one half of a transmission burst with the symbols carrying the signalling information.
6. A method according to claim 5, wherein the step of transmitting the symbols carrying the signalling information comprises the substep of filling exactly one half of each of a number of consecutive complete transmission bursts with the symbols carrying the signalling information.
7. A method according to claim 5, wherein the step of transmitting the symbols carrying the signalling information comprises the substep of filling exactly one half

of each of a number of non-consecutive complete transmission bursts with the symbols carrying the signalling information.

8. A method according to claim 1, wherein additionally a first phase modulation method of first modulation depth is used to generate the symbols carrying user data in a transmission burst, and the step of formatting a piece of signalling information into symbols comprises the substep of using a second phase modulation method of second modulation depth, lower than said first modulation depth, to generate the symbols carrying signalling information in a transmission burst.
9. A method according to claim 8, wherein said first modulation method is 8-PSK and the second modulation method is GMSK.
10. A method according to claim 8, wherein a first phase rotation scheme is used to generate the symbols with the first modulation method and a second phase rotation scheme is used to generate the symbols with the second modulation method, said second phase rotation scheme being essentially indistinguishable from the first phase rotation scheme.
11. A method according to claim 10, wherein to indicate within a certain transmission burst that it contains symbols carrying signalling information, the method comprises the step of placing a number of flag symbols having a certain indicator value within said transmission burst.
- 20 12. A method according to claim 11, wherein additionally a transmission burst consists of a first half, a training sequence and a second half, and only one half of a transmission burst is filled with the symbols carrying the signalling information, and the method comprises the step of placing two flag symbols within said transmission burst to indicate which half of the transmission burst contains symbols carrying signalling information.
- 25 13. A method according to claim 8, wherein a first phase rotation scheme is used to generate the symbols with the first modulation method and a second phase rotation scheme is used to generate the symbols with the second modulation method, said second phase rotation scheme being essentially distinguishable from the first phase rotation scheme; and the use of the second phase rotation scheme indicates within a certain transmission burst that it contains symbols carrying signalling information.

14. A transmitting device for transmitting signalling information to a receiving device in a cellular radio network over a traffic channel in discrete transmission bursts consisting of consecutive symbols, comprising:
- means for formatting a piece of signalling information into symbols,
 - 5 - means for transmitting the symbols carrying the signalling information as a block of consecutive symbols in a certain transmission burst of a traffic channel and
 - means for indicating within said certain transmission burst that it contains symbols carrying signalling information.
15. A transmitting device according to claim 14, comprising a dual-mode phase modulator for applying a first phase modulation method of first modulation depth to generate the symbols carrying user data in a transmission burst and a second phase modulation method of second modulation depth, lower than said first modulation depth, to generate the symbols carrying signalling information in a transmission burst.

ABSTRACT

Signalling information is conveyed from a transmitting device (101) to a receiving device (102) in a cellular radio network where user data transmission takes place on a traffic channel in discrete transmission bursts (111-120; 211-220; 310-313) consisting of consecutive symbols. A piece of signalling information is formatted into symbols which are transmitted as a block of consecutive symbols (FACCH) in a certain transmission burst of a traffic channel. It is also indicated within said certain transmission burst that it contains symbols carrying signalling information.

Fig. 1

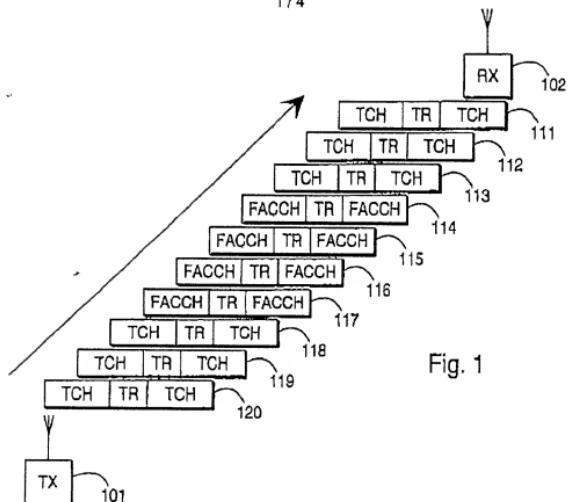


Fig. 1

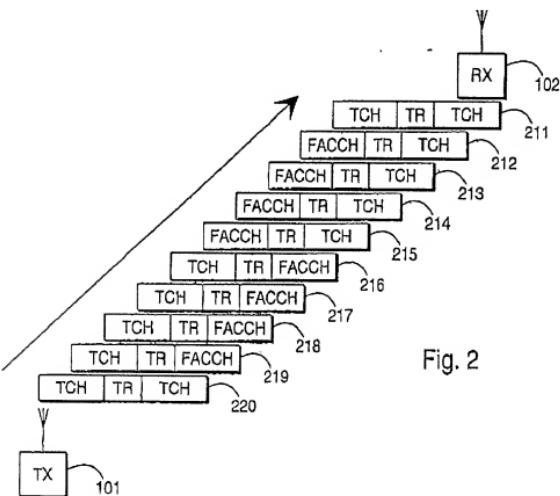


Fig. 2

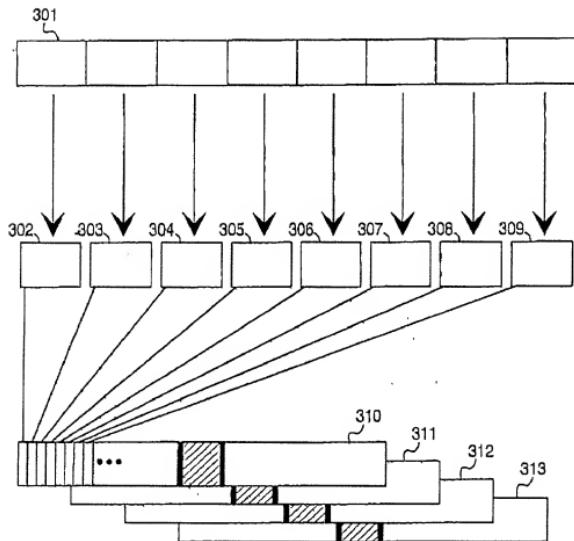


Fig. 3

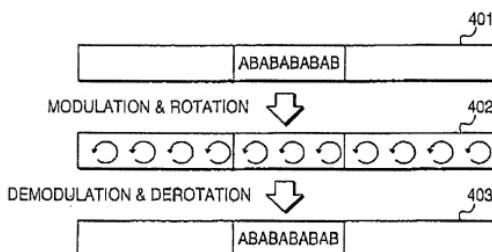


Fig. 4

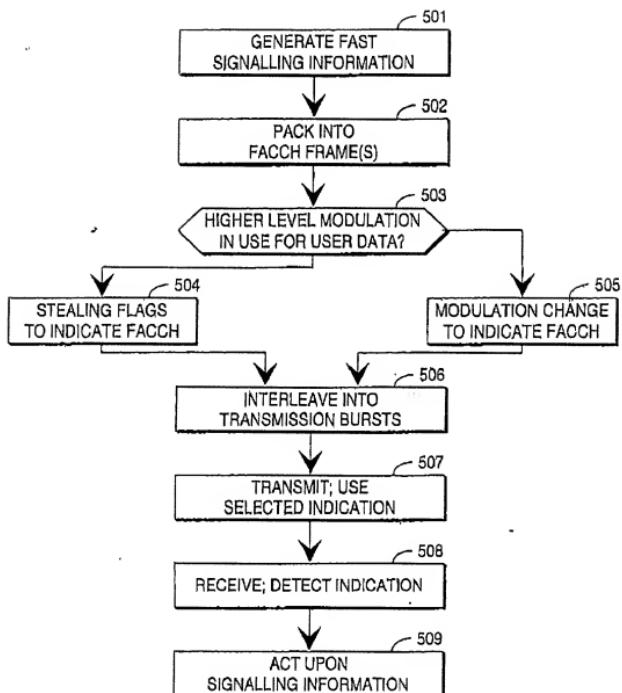


Fig. 5

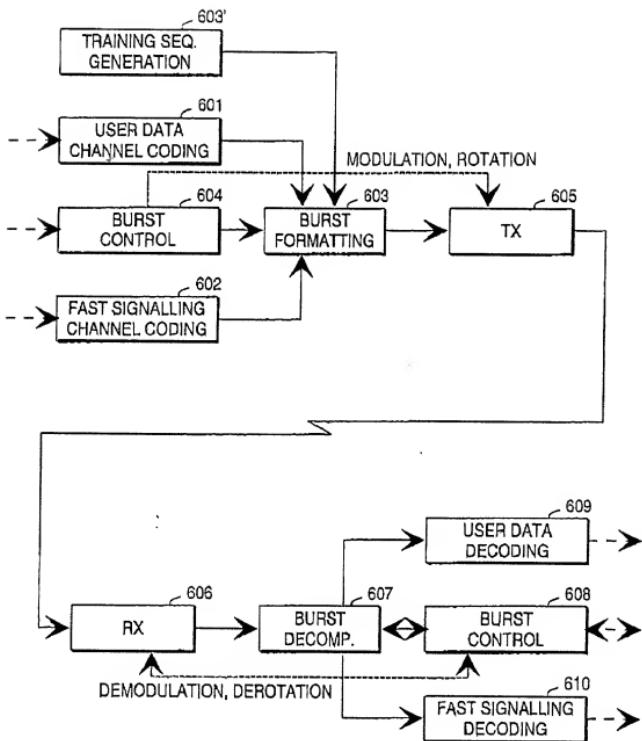


Fig. 6